

Computer Graphics & Animation: CS Day @ SIUC

This session explores computer graphics and animation using software that will let you create, display and animate 3D Objects. Basically we will create a 3 dimensional description of an object in the computer (*modeling*) and then simulate what it would look like based upon shining light on it and creating an image using a synthetic camera (*rendering*). An animation will show the object moving in time.

Session website: www.cs.siu.edu/~wainer/AOIpractice/CSDAYwithAOI.html

Objects can be defined within the computer by specifying their geometry and surface properties. To make it easier to define objects, applications (created by Computer Scientists 😊) are commonly used. We'll be using the program *Art of Illusion* (free download at <http://www.artofillusion.org/>) for this purpose.

1. Open Art of Illusion

- Notice the **view windows** and tool palette. View windows show the world from different views. Grids can be turned on/off through the *Scene -> Grid ...* menu. The Grid snap feature makes it easier to place items at precise locations,
- Tools** let you create and manipulate objects. They are shown in the color coded guide on the right.

BLUE: creates objects

GREEN: manipulates objects

BROWN: manipulates the view

AOI Tool Palette

move object		rotate object
resize object		create a cube
create a sphere		create a cylinder
		create a polygon
create light source		create interp curve
create apprx curve		move viewer
rotate viewer		

AOI main Window

The screenshot shows the main window of Art of Illusion with several key components labeled:

- tools:** A vertical toolbar on the left side of the window.
- view windows:** Four orthographic views: front view, left view, top view, and camera view. A light source is visible in the camera view.
- object list:** A panel on the right showing a list of objects: Camera 1, Cylinder 1, and Point Light.
- properties:** A panel on the right showing the properties of the selected object (Cylinder 1), including Name, Position (X, Y, Z), Orientation (X, Y, Z), and Material.
- animation tracks:** A timeline at the bottom showing keyframes for the selected object's position and rotation.

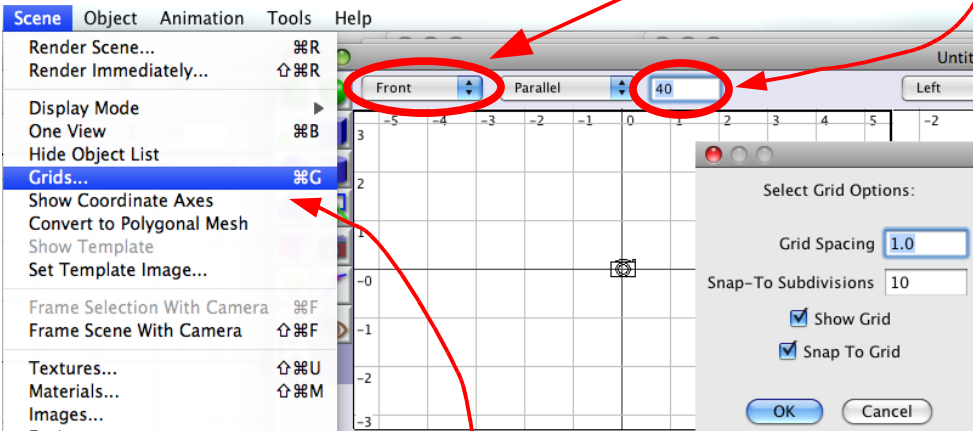
Building a Rocket

As an example of a model, we'll show how to build a rocket and then animate it. Follow through the basic sequences first, then you'll also be able to try your own variations.

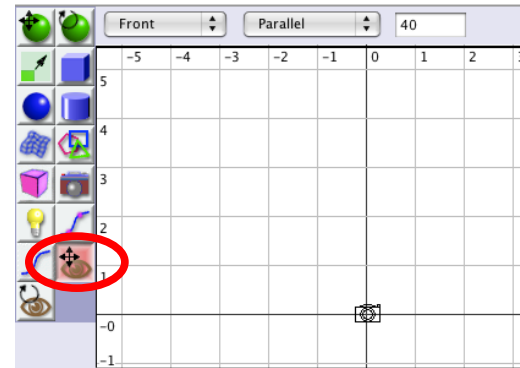
2. Getting Ready to Work: setting grid & coordinate range

a. The Scene Menu has a Grid option to show the grid and turn snapping on.

b. The magnification number can be lowered to show more of the scene. These modifications apply to the current view window.



c. Use the “*Move Viewer*” tool to show more of a positive y range in the Front view window.

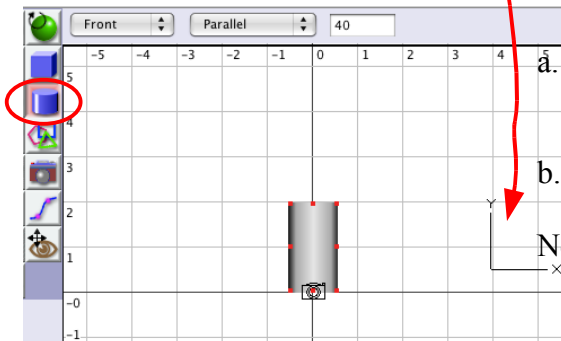


3. Making the Rocket Body

a. Use the “*Cylinder*” tool to create a cylinder in the Front view window. Make the cylinder bottom at $y=0$, with a height of 2 and width of 1 centered about $x=0$.

b. Use the “*Move*” and “*Resize*” tools if needed. Delete extra objects or start over again if needed.

Notice how the same cylinder also appears in the other view windows.



4. Adding some Color

Object colors are determined by their surface properties (texture, material) and how light bouncing off of them is reflected to the viewer. With your cylinder still selected:

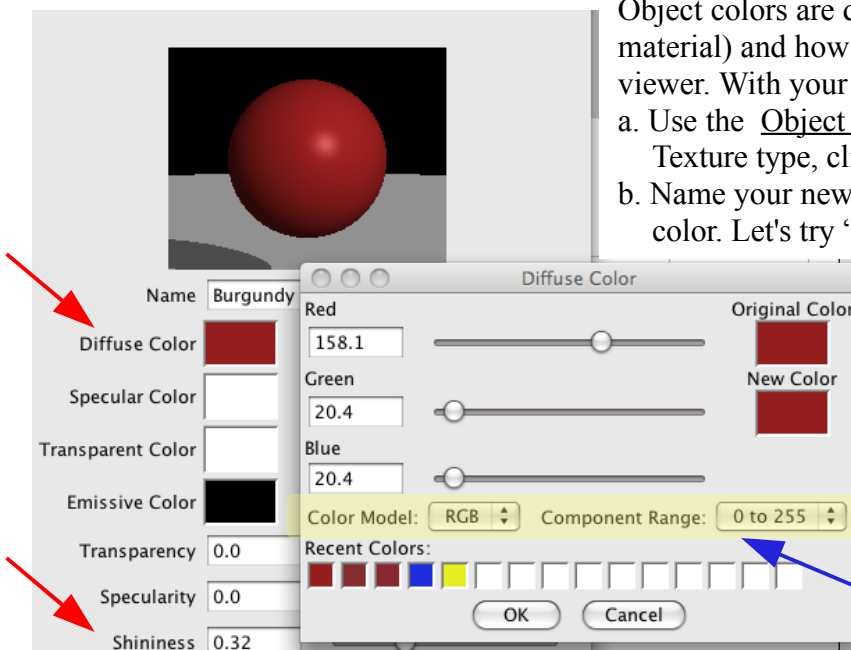
a. Use the Object Menu, Set Texture, option. Using a Simple Texture type, click New Texture.

b. Name your new uniform texture – which will basically be a color. Let's try “Burgundy”. Type in the name and click OK.

c. To define your color, click the Diffuse Color box – another popup will let you adjust the color to your liking. Once you're happy, click OK.

d. You might also like to give your texture some “*Shininess*”.


e. Keep clicking OK until all the extra dialogs are dismissed. Your object should appear with the new color.

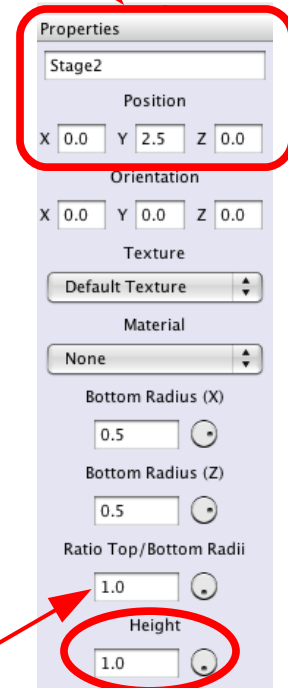
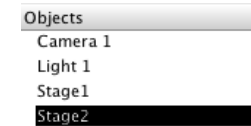
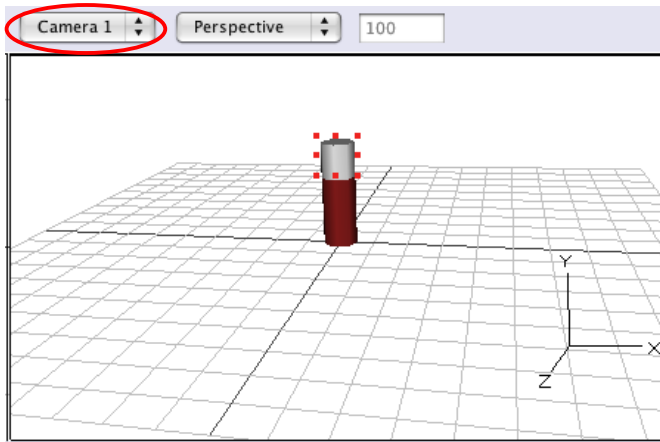


Notice: that different color models can be used

Building a Rocket, continued.


5. Adding Stage 2

- Create another cylinder of height 1 in y to be the second stage.
- Set it on top of the first stage. No need to change the color just yet.
- Find the Cylinders you created in the Object List (on the right). Rename the objects to Stage1 and Stage2. You may also adjust the position and size of the cylinders. Properties will be different depending upon the type of object selected.
- Select the “Rotate Viewer”  tool and move to the *Camera 1* view. Adjust the view angle a bit to get a better look at your objects.



Set to zero to make a cone

Selecting Objects

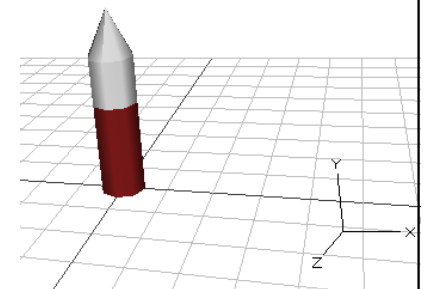
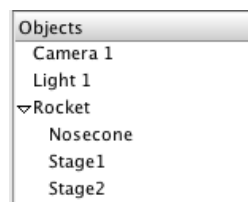
Objects are selected using the “Object Move”  tool or by clicking on the object in the Object List.

6. Add a Nosecone

- Select Stage2 and Copy/Paste it to make a duplicate. Look in Edit Menu or use Control-C for copy and Control-V for paste.
- The duplicate will be right on top of the original. In the *Front view*, use the “Object Move” tool to drag it up 1 unit in y.
- Using the **Properties**, change the name to Nosecone and convert it to a cone by changing the “Ratio Top/Bottom Radii” to 0.

7. Group all the Parts into a Rocket Object

- Use the Object Menu, Create Primitive option to create a “Null” object. This works like a folder to group other parts together.
- In **Properties**, change its name to *Rocket*.
- In the **Objects List**, drag the names of other objects to be inside of *Rocket*.




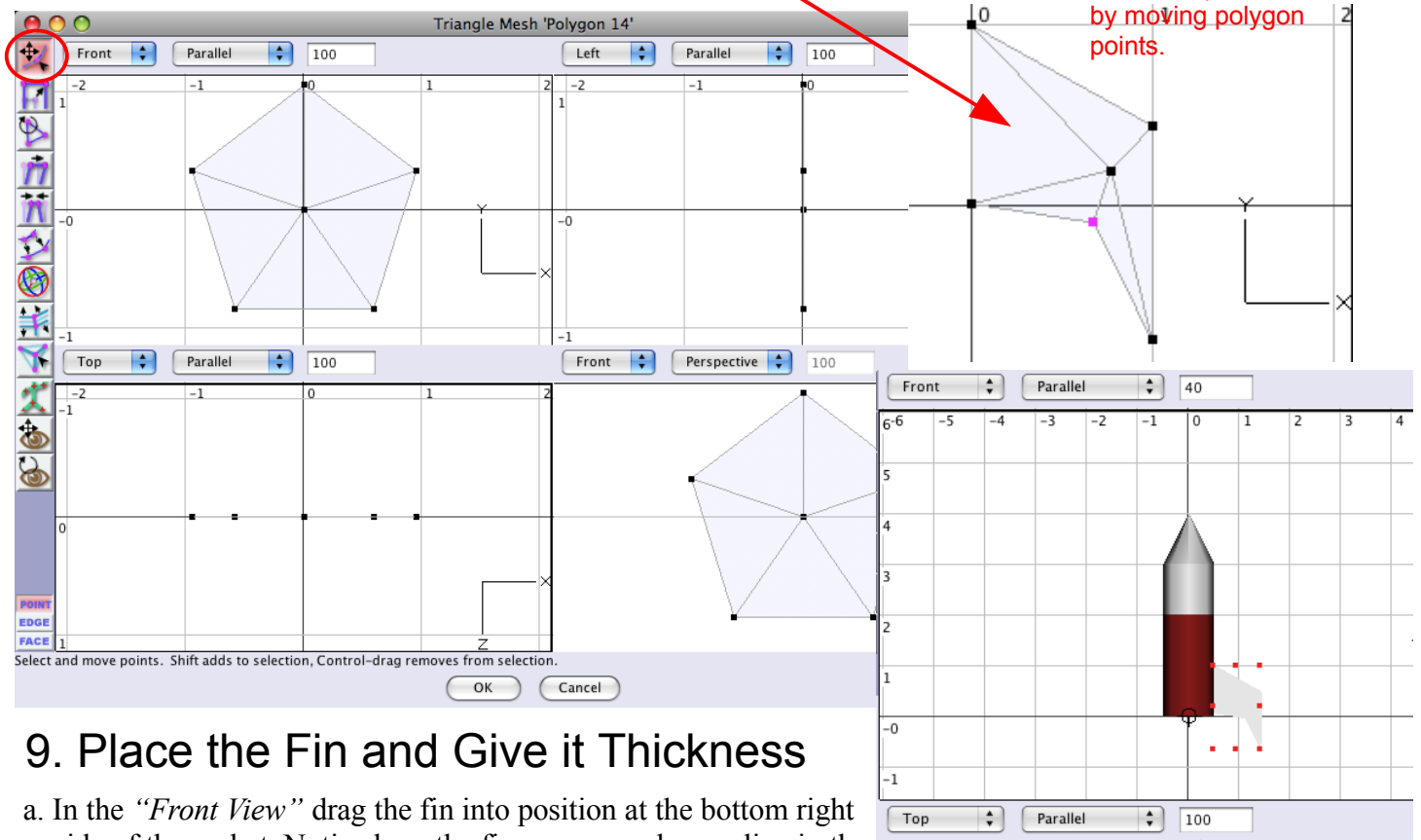
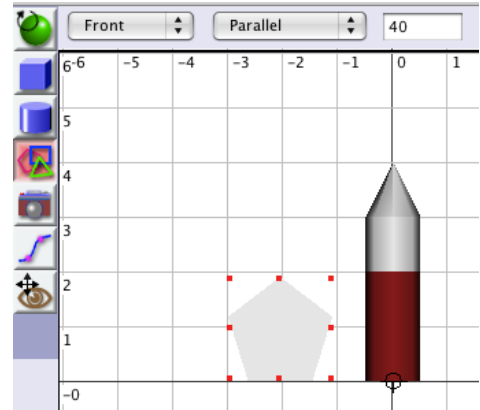
Your object list should look like that on the right.



Building a Rocket, creating a tailfin

8. Making a Single Tailfin

- Double-click the “Create Polygon” Tool.  Set it to create 5 sided angled polygons.
- Hold the control key down, and use the “Create Polygon” Tool to create a polygon roughly 2x2 in size. You won't be making the exact shape just yet.
- Change to the “Move Object” Tool to select and double-click on your new polygon to open the mesh editor as shown below.
- With the “Move Point” Tool, adjust the shape of the Triangle Mesh (Polygon) within the Front view to make a good tailfin. Click-OK when you have a shape similar to that shown.

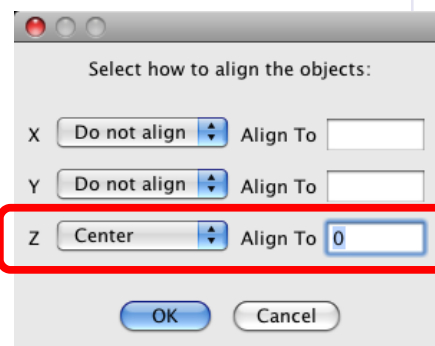


Tailfin shape created by moving polygon points.

When first created, the tailfin has no thickness.

9. Place the Fin and Give it Thickness

- In the “Front View” drag the fin into position at the bottom right side of the rocket. Notice how the fin appears only as a line in the “Top View”. It has no thickness!
- With the fin selected, open the Tools Menu pick Scripts and choose “Thicken”. Enter a thickness of 0.1 and click OK.
- You should see your fin thickened but it is no longer evenly centered about the Z=0. Use the Object Menu and select “Align Objects...”. Only Center align Z values to the number 0.



Building a Rocket, creating a set of tailfins

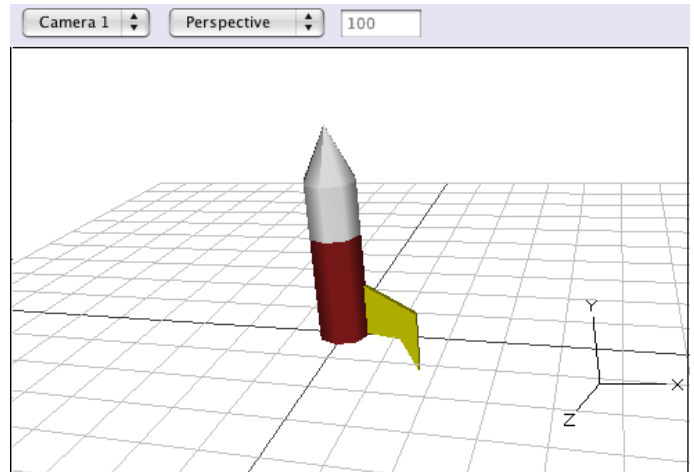
10. Rename and Color the Tailfin

- Rename your object to “Fin”. (Recall Step 5c.)
- Create a new “Yellow” texture for “Fin”. (Recall Step 4). Hint: High Red and Green values make Yellow in the RGB Color system.

You should have something like that on the right

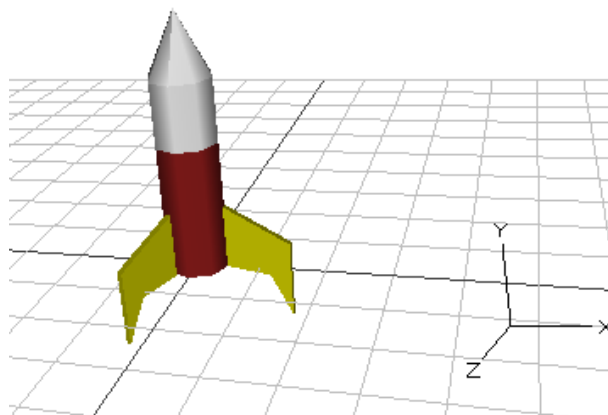
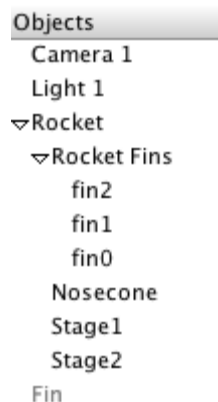
Scripts

Software can often automate repetitive, tedious and/or complex tasks to remove the burden from users.



11. Making More Fins

- Select the *Rocket* and all its parts in the Object List. Use the Object Menu, “Hide Selection” to temporarily make the Rocket body invisible.
- Position the Rocket fin so its left side lines up against the y-axis. Make the bottom left side lie at the origin. Make sure the rocket fin is still selected.
- Use the menu, Tools, Edit Script A text window appears for a script to be entered. Copy/Paste the script Tailfins.bsh (URL: <http://www.cs.siu.edu/~wainer/AOIpractice/TailFins.bsh>)
- Execute the script. It will ask you for the number of Rocket Fins and Radius of Rocket. Enter 3 and 0.5 respectively. After the script finishes, 3 new rocket fins will appear.
- Hide the original Rocket Fin (as in step 11a above).
- Make a new Null object; name it “*Rocket Fins*” and place all 3 new fins within it. (Recall step 7).
- Unhide the *Rocket* (select in Object list and use the Object Menu, “Show Selection” command) and group *Rocket Fins* within the *Rocket* object.



Flying the Rocket

Animation

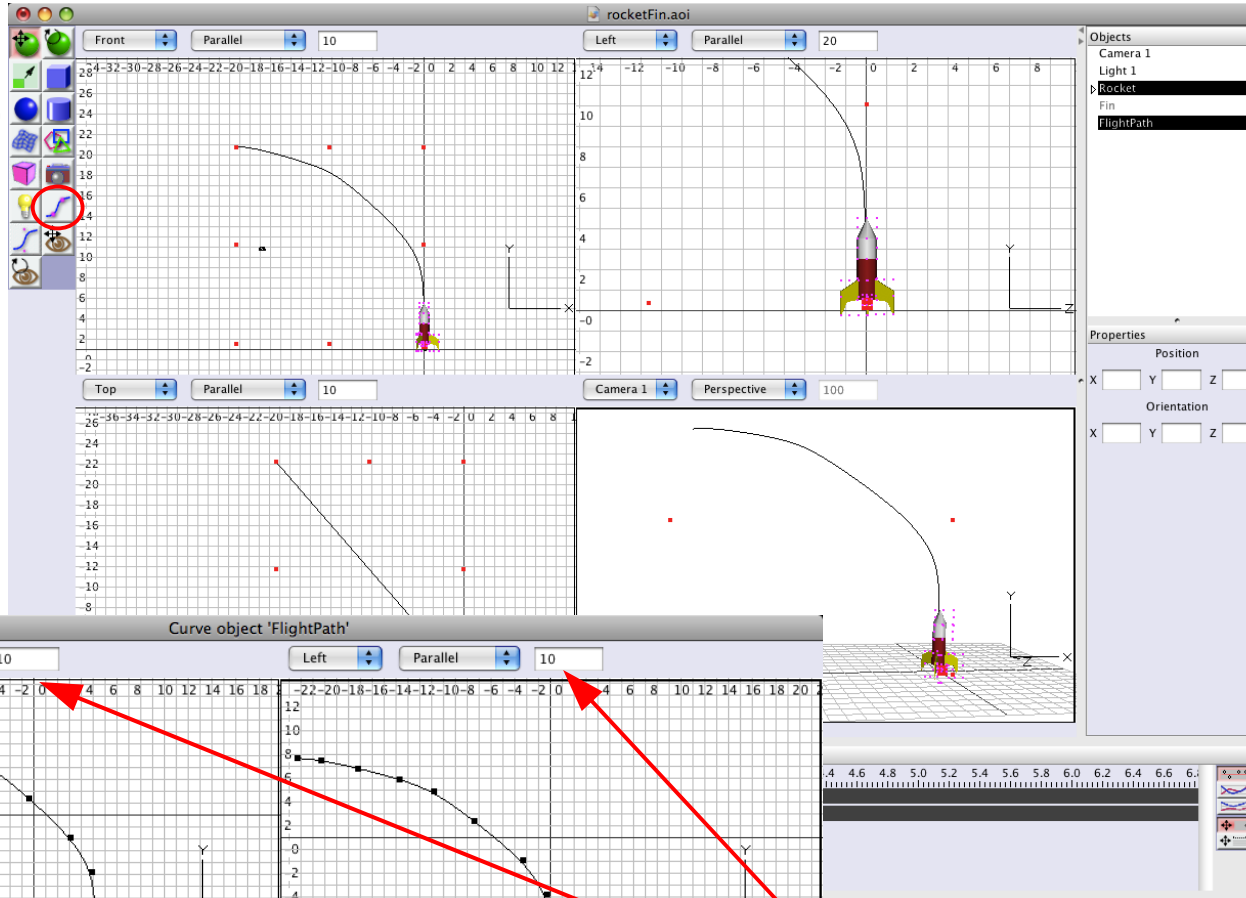
A sequence of images is created to show how a scene varies in time. When played back at an appropriate speed, the effect of motion is created.

12. Create a Flight Path

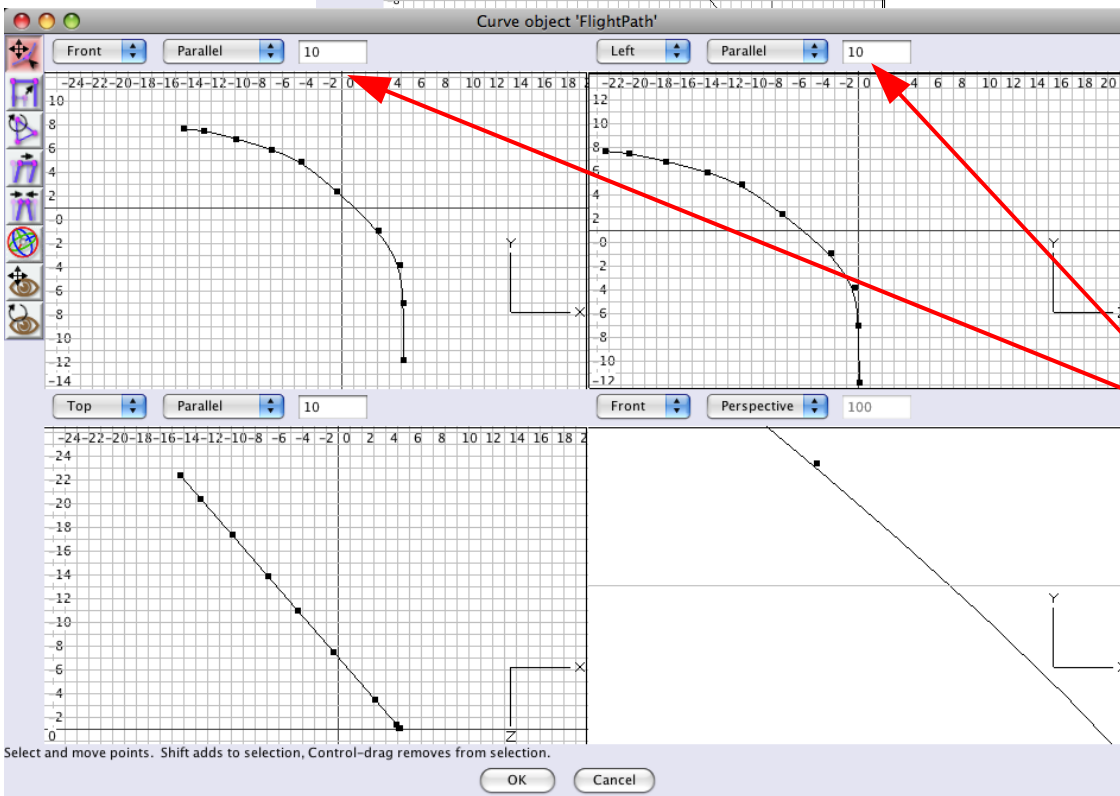
To make the rocket fly, we'll create a flight path using a curve, and then tell the rocket to follow that path.

- a. Adjust the Front View and Left View magnification to view more of the scene (use a number close to 10)
- b. In the Front View use the Interpolate Curve Tool to create a curve that starts on the ground and arcs up into the sky.

- c. Edit the Curve Object (Object Menu, Edit Object) to adjust the points with more control. Click OK when finished. A more detailed curve editor window will pop-up. See below.



Curve Editor



Adjust the magnification and grid settings in these windows as needed. Once back in the regular scene editor, you can drag and resize the flight curve.

Feel free to delete a curve if it becomes hard to deal with – you can make a new one and try again.

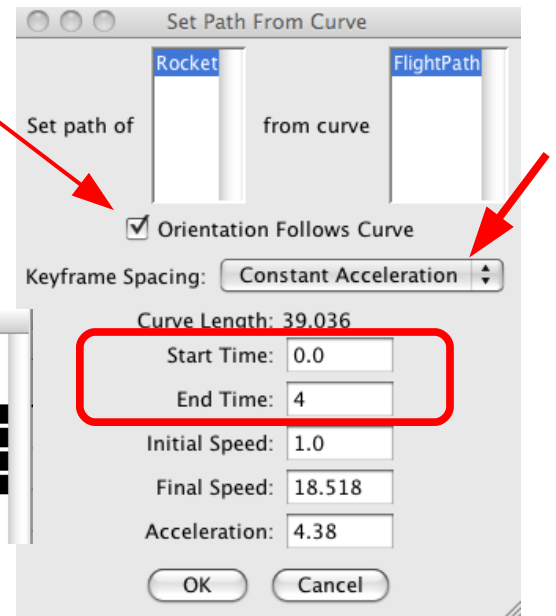
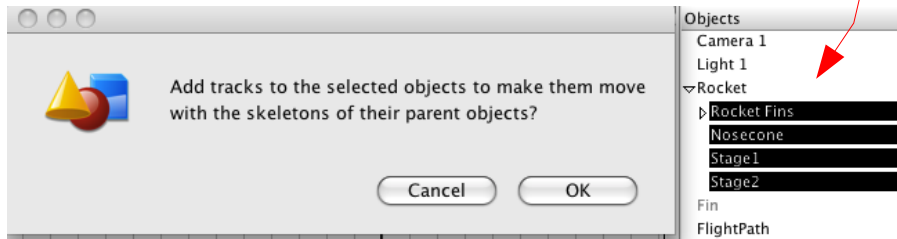
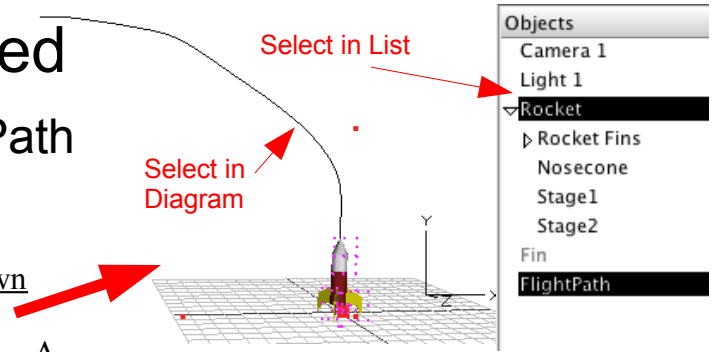


- d. Use **Properties** to rename the curve you just created to “FlightPath”.

Flying the Rocket, continued

13. Attach the Rocket to its Flight Path

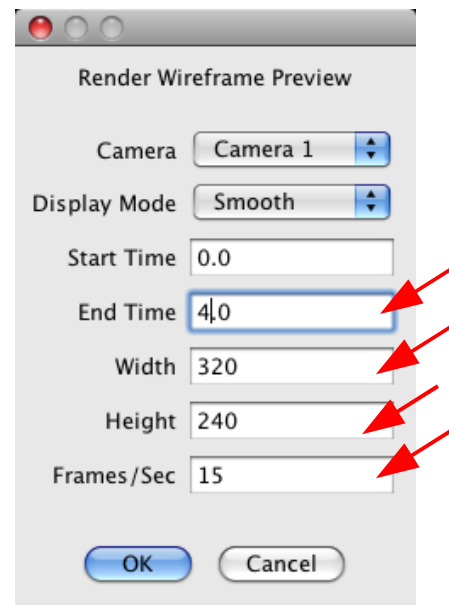
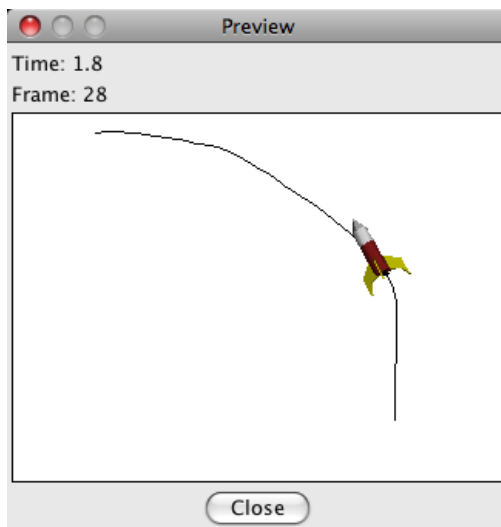
- Select both the *FlightPath* Curve and *Rocket* Objects. (Select the first object and then hold the Shift key down while clicking on the second object)
- In the Animation Menu, select, *Set Path From Curve ...* A dialog box will pop-up. Make sure the “*Orientation Follows Curve*” under *Constant Acceleration* is clicked and that Start Time and End time go from 0 to 4. The other values will be generated for you. Click OK.
- Select the objects within “Rocket” and in the Animation Menu, choose the “*Bind to Parent Skeleton ...*” option. This makes sure the rocket parts follow the rocket grouping along the curve.



A Confirmation box will appear. Click OK.
You'll see new animation tracks appear along the bottom in the animation view.

14. Seeing it Move

- In the Animation Menu, select, *Preview Animation...* A dialog box will pop-up. Make sure the settings are as shown then Click OK.
- A preview of the Rocket Motion will be generated. If you need to change things you'll have to go back and modify your work – change the *FlightPath* etc.

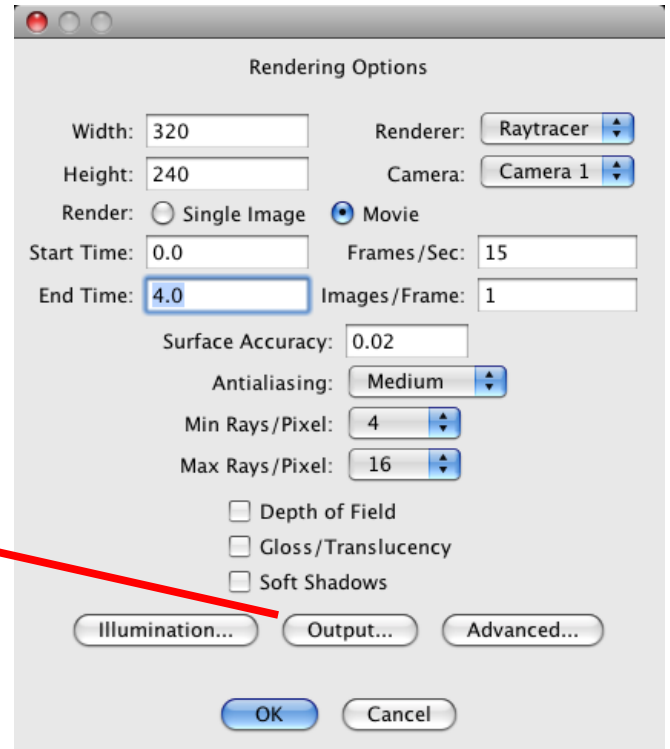
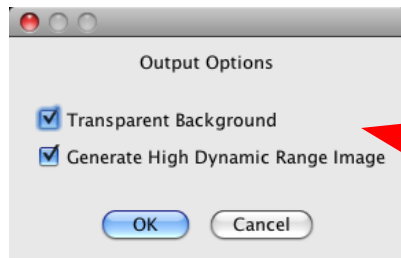


Close the Preview when you've finished viewing it.

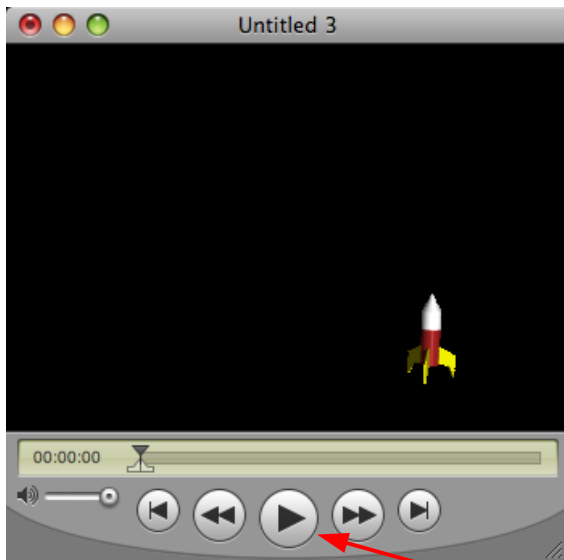
Turning the Animation into a Movie

15. Generating the Frames

- Select from the Scene Menu, Render Scene... This will open a dialog box. Make sure all the fields are filled in as they are shown to the right. This determines the size of images for the movie, the range of simulated time that should be generated and the playback speed.
- Click the *Output ... options* button and make sure that images with a transparent background are generated.
- Click OK to close the *Output and Rendering Option* boxes.



- Next another dialog will appear asking for the format (Pick PNG) and the starting number for the frames. Pick 1. Click OK.
- Next you will get a chance to pick the root name of your image sequence (60 files) and where to store it. Please make a folder under My Documents such as *csDay*. Within that folder give a name like "*launch.png*". Click OK. The images will be generated and saved automatically – it might take a little while.



16. Stitching Frames into a Movie

- Start the Quicktime Player (Pro) application.
- From the File menu, select *Open Image Sequence*. Go to the folder where you saved the frames that AOI generated and pick the one with the lowest number.
- When asked for the frame rate, pick 15. Hit OK.
- The frames are stitched together to make a movie. You can play it play clicking on the Play button.

The background is shown as black but it is also transparent!

Turning the Animation into a Movie

17. Compositing with a Background

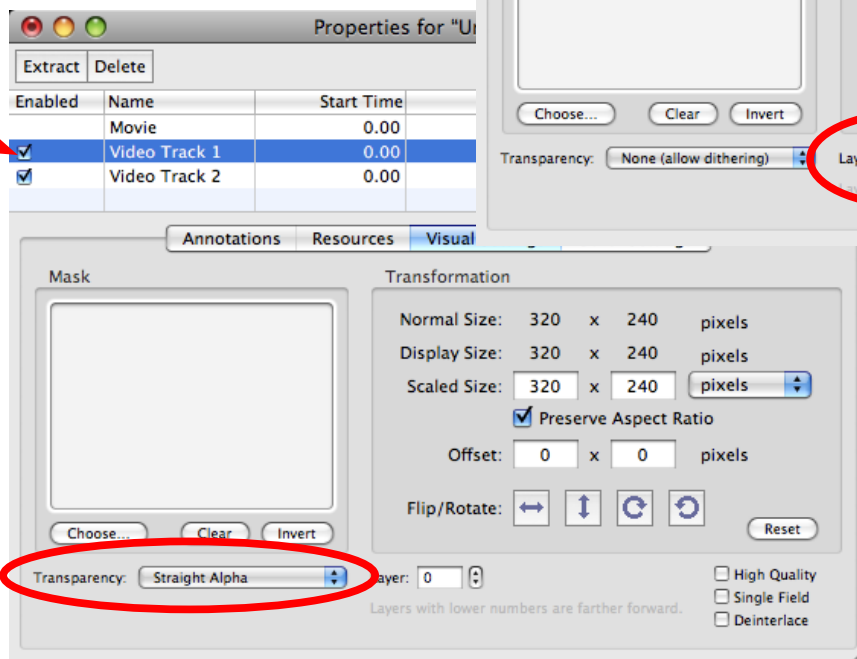
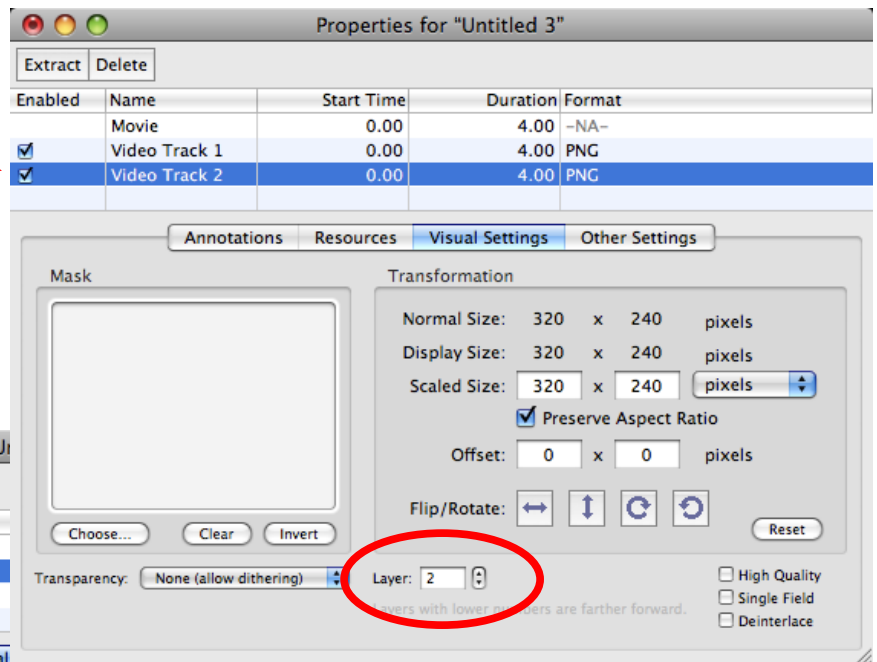
- From the Quicktime File menu, *Open* the background image “*launchBg.png*” available from the web. Another Quicktime player window opens.
- In the Edit Menu, Choose *Select All* and then *Copy*.
- Back in the Quicktime Player showing your Rocket movie, use the Edit Menu, *Select All* option also (but DON'T copy)
- Position the time index to 0
- Use the Edit Menu, *Add to Selection and Scale* option



18. Adjusting the Tracks

Your movie now has 2 tracks. Track 1 has the rocket frames and track 2 has the still background image. But it has to be moved behind the rocket images.

- Open the Quicktime Window Menu, “*Show Movie Properties ...*” and Select *Visual Settings* as shown
- Select (highlight) *Video Track 2* and adjust the *Layer Number* to be 2. This will move it behind the rocket frames.
- To make the rocket frames transparent, select *Video Track 1* and adjust the *Transparency* to *Straight Alpha*.



You should see a result similar to that at the top.

Try playing your movie now!

Many special effects combine computer generated images with real ones.

Some Other Things to Try

v2.01

19. Save Your Movie by Exporting From Quicktime

20. Add More Scenes to Your Movie

Create a new flight path and use a different background image. Add to previous movie.

21. Making Your Rocket Explode

Animation Menu, Add Track to Selected Items, Distortion, Shatter

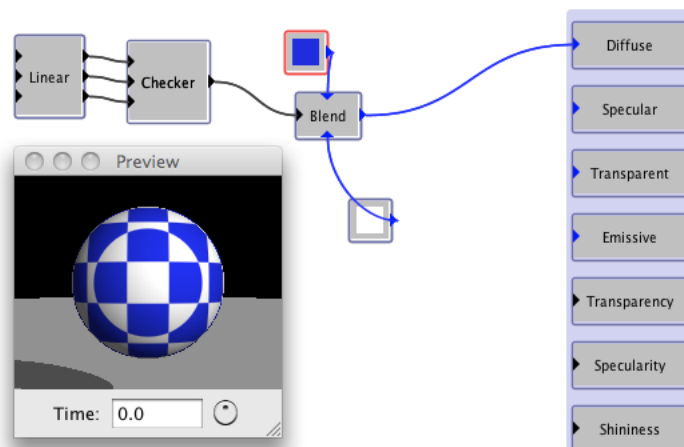
22. Add More Details

Add additional geometry to your rocket – try an exhaust port made by subtracting a smaller cone (or sphere) from a larger one. Tools menu, Boolean Modeling

23. Add Other Objects to the Scene

Check out the *Art of Illusion Gallery*

24. Try Making a Procedural Texture



25. Experiment with Rendering

For starters, just try Scene Menu, *Display Mode*

Thanks for joining us for CS Day at SIUC. We hope you enjoyed it .
- Dr. Michael Wainer <http://www.cs.siu.edu/>